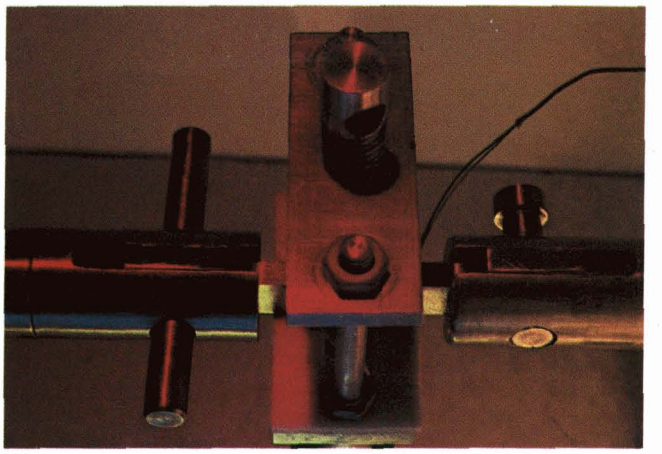
ULTRASONIC MONITOR



Below, Dr. Kamel Salama of the University of Houston's Mechanical Engineering Department is using a NASA-developed stress monitor on a test specimen, which is in the chamber (yellow window) at his back. The instrument is the Model PLR-1000 Ultrasonic Interferometer, manufactured by MicroUltrasonics, Inc., Williamsburg, Virginia. MicroUltrasonics is one of 12 companies licensed by NASA for commercial production of the system originally developed by Langley Research Center and known as the Pulse Phase Locked Loop Bolt Stress Monitor, or P^2L^2.

The system was designed to provide highly precise stress measurement in industrial applications—such as pressure vessels and power plants—where overtightened or undertightened bolts can fail and cause accidents or costly equipment shutdowns. P^2L^2 measures the stress that occurs when a bolt becomes elongated in the process of tightening. The instrument transmits sound waves to the bolt being tightened and receives a return signal indicating changes in bolt stress, changes somewhat analogous to the tone changes in a violin string being tightened. The results are translated into a digital reading of bolt stress. MicroUltrasonics' PLR-1000 is a refined, microprocessor-controlled version of the P^2L^2, usable on bolts, plates, liquids and gases.

Kamel Salama learned, through a colleague, that NASA was using a new monitor to measure stress in fasteners on the Space Shuttle's external fuel tank and on wheel bolts in the Shuttle Orbiter's landing gear. The instrument proved ideal for his own work, which is aimed at development of a new technique for nondestructive measurement of residual stress in various types of structures—for example, nuclear pressure vessels, pipes in nuclear reactors, offshore platforms, bridges, railroad tracks and wheels, aircraft wings and engines. Surface stress can be measured by x-ray devices, but bulk residual stresses—those due to causes other than application of external forces or heat—can only be measured by ultrasonics. Salama is using the PLR-1000 to generate calibrations that will allow measurements of residual stress in the field. The instrument produces sound tone pulses that travel through a test specimen, such as the steel bar shown above. The PLR-1000 precisely measures the phase delay (speed) at which the pulse passes through the specimen; since the speed changes when stress changes, the measurements tell how much stress there is at a specific calibration. The PLR-1000 has a resolution of one part per million, thus enabling Salama to achieve measurements that in the past were difficult if not impossible.